Claims

1. A quantum information processing element comprising

a cage defining a cavity formed from a plurality of self-assembling protein molecules, and

one or more cargo elements located within the cavity, wherein at least one of the cargo elements comprises a qubit programmable into a plurality of logical states.

2. A quantum information processing element according to claim 1, comprising receptors for capturing and positioning one or more cargo elements within the cavity.

3. A quantum information processing element according to claim 2, comprising a vesicle located within the cage and enclosing one or more cargo elements, wherein the receptors extend through the vesicle to capture and position a cargo element within the vesicle.

4. A quantum information processing element according to claim 3, comprising adaptors disposed between the receptors and the cage and binding to the receptors.

5. A quantum information processing element according to claim 1, comprising a vesicle located within the cage and enclosing the one or more cargo elements.

6. A quantum information processing element according to claim 1, comprising molecular tethers for capturing and positioning one or more cargo elements within the cavity.

7. A quantum information processing element according to claim 1, comprising direct cage bonding for capturing and positioning one or more cargo elements within the cavity.

8. A quantum information processing element according to claim 1, comprising receptors, molecular tethers and direct cage bonding for capturing and positioning one or more cargo elements within the cavity.

9. A quantum information processing element according to claim 1, comprising one or more cargo elements forming a non-permeable cavity.

10. A quantum information processing element according to claim 3, comprising a vesicle forming a non-permeable cavity.

11. A quantum information processing element according to claim 1, comprising a self-assembling cage that is electrically neutral and inhibits charge transfer between the cage and its enclosed cargo elements.

12. A quantum information processing element according to claim 1, comprising a self-assembling cage that reduces the tendency of a plurality of logical states in a coherent state to collapse into a decoherent state.

13. A quantum information processing element according to claim 1, comprising a non-qubit-only cage that inhibits non-quantum information processing cargo elements from interfering with qubit cargo element operation in other cages.

14. A quantum information processing element according to claim 3, comprising a self-assembling vesicle that is electrically neutral and inhibits charge transfer between the vesicle and its enclosed cargo elements.

15. A quantum information processing element according to claim 3, comprising a self-assembling insulative vesicle that reduces the tendency of a plurality of logical states in a coherent state to collapse into a decoherent state.

16. A quantum information processing element according to claim 4, comprising self-assembling receptors and adaptors that are electrically neutral and inhibit charge transfer between the vesicle and cage and their enclosed cargo elements.

17. A quantum information processing element according to claim 1, comprising a self-assembling cage that reduces contaminant background radiation to cargo carried within the cage.

18. A quantum information processing element according to claim 3, comprising a self-assembling vesicle that reduces contaminant background radiation to cargo carried within the vesicle.

19. A quantum information processing element according to claim 1, comprising a self-assembling framework of cages to structurally support one or more self-assembling QIP elements.

20. A quantum information processing element according to claim 1, comprising a self-assembling electrically neutral substrate of cages to structurally support one or more self-assembling QIP elements.

21. A quantum information processing element according to claim 1, comprising a self-assembling framework of cages to structurally order one or more self-aligning QIP elements.

22. A quantum information processing element according to claim 1, wherein a cage is empty and includes no cargo elements.

23. A quantum information processing element according to claim 1, wherein the one or more cargo elements is a single cargo element comprising a qubit programmable into a plurality of logical states.

24. A quantum information processing element according to claim 1, wherein the one or more cargo elements are a plurality of cargo elements.

25. A quantum information processing element according to claim 24, wherein the plurality of cargo elements are qubits programmable into a plurality of logical states.

26. A quantum information processing element according to claim 24, wherein at least some of the plurality of cargo elements are quantum information processing cargo elements

27. A quantum information processing element according to claim 24, wherein at least some of the plurality of cargo elements are non-quantum information processing cargo elements.

28. A quantum information processing element according to claim 1, wherein the cargo elements respond to stimuli internal and external to the cage.

29. A quantum information processing element according to claim 3, wherein a vesicle and its contained cargo elements respond to stimuli internal and external to the vesicle.

30. A quantum information processing element according to claim24, wherein a subset of the non-quantum information processing cargo elements include one or more therapeutic agents.

31. A quantum information processing element according to claim 24, wherein a subset of the non-quantum information processing cargo elements include one or more diagnostic agents.

32. A quantum information processing element according to claim 24, wherein a subset of non-quantum information processing cargo elements include one or more sensor agents.

33. A quantum information processing element according to claim 24, wherein a subset of non-quantum information processing cargo elements include one or more prosthetic agents.

34. A quantum information processing element according to claim 24, wherein a subset of qubit and non-quantum information processing cargo elements include one or more quantum dots.

35. A quantum information processing element according to claim 24, wherein a subset of the cargo elements include one or more photonic dots.

36. A quantum information processing element according to claim 24, wherein a subset of the cargo elements include one or more liquids without dopants or with one or more dopants of any suitable type.

37. A quantum information processing element according to claim 24, wherein a subset of the cargo elements include a gas or vapor without dopants or with one or more dopants of any suitable type.

38. A quantum information processing element according to claim 1, wherein one or more qubit cargo elements are programmed by one or more pulses of electromagnetic radiation.

39. A quantum information processing element according to claim 38, wherein the electromagnetic radiation has a frequency in the UHF region.

40. A quantum information processing element according to claim 38, wherein the electromagnetic radiation has a frequency in the microwave region.

41. A quantum information processing element according to claim 38, wherein the electromagnetic radiation has a frequency in the radio region.

42. A quantum information processing element according to claim 1, wherein the qubit includes an unpaired electron and the plurality of logical states of the qubit are defined by electron spin polarization.

43. A quantum information processing element according to claim 1, wherein the qubit includes a nucleus and the plurality of logical states of the qubit are defined by nucleus spin polarization.

44. A quantum information processing element according to claim 1, wherein the qubit includes an unpaired electron and the plurality of logical states of the qubit are defined relative to an energy difference.

45. A quantum information processing element according to claim 1, wherein the qubit includes a nitroxide molecule.

46. A quantum information processing element according to claim 1, wherein the qubit includes a free radical molecule.

47. A quantum information processing element according to claim 1, wherein the qubit is photon-based and the plurality of logical states of the photon-based qubit include a coherent logical state.

48. A quantum information processing element according to claim 1, wherein the plurality of logical states includes a coherent state.

49. A quantum information processing element according to claim 1, wherein the plurality of logical states includes a coherent state at room temperature.

50. A quantum information processing element according to claim 1, wherein the self-assembling protein molecule is a clathrin molecule.

51. A quantum information processing element according to claim 1, wherein the cage comprises self-assembling synthetic protein molecules.

52. A quantum information processing element according to claim 4, wherein receptors, adaptors, and vesicle comprise natural or synthetic protein molecules.

53. A quantum information processing element according to claim 1, comprising a metallic coating on part or the entirety of the cage.

54. A quantum information processing element according to claim 4, comprising a metallic coating on a portion or an entirety of the receptors, adaptors, and vesicle.

55. A quantum information processing element according to claim 1, wherein the cage is substantially greater than one nanometer in diameter.

56. A quantum information processing element according to claim 1, wherein the cage is at least about 50 nanometers in diameter.

57. A quantum information processing element according to claim 1, wherein the cage is at least about 100 nanometers in diameter.

58. A quantum information processing element according to claim 1, wherein the cage is symmetric with respect to a plane.

59. A quantum information processing element according to claim 1, wherein the cage has icosahedral geometry.

60. A quantum information processing element according to claim 1, wherein qubits are linearly positioned at vertices along a single plane using circulant ordering.

61. A quantum information processing element according to claim 1, wherein multiple quantum information processing elements are physically linked together.

62. A quantum information processing element according to claim 1, wherein multiple self-assembling QIP elements are functionally linked together, either locally or at a distance.

63. A quantum information processing element according to claim 1, wherein the quantum information processing element forms a hybrid system upon its physical or functional integration with non-invention elements in vitro and in vivo.

64. A method for forming a quantum information processing element comprising

forming from self-assembling protein molecules a cage defining a cavity, and locating one or more cargo elements within the cavity, wherein

at least one of the cargo elements comprises a qubit programmable into a plurality of logical states.